KECHIKA ENHANCEMENT PROJECT OF NORTHEASTERN B.C. WOLF/UNGULATE MANAGEMENT 1983-84 ANNUAL REPORT

Ministry of Environment
Fish and Wildlife Branch
Fort St. John, B.C.

Wildlife Working Report No. WR-6
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by

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ABSTRACT

This report identifies work completed for the Kechika wolf/ungulate management project during the 1983/84 fiscal year and describes wolf and ungulate population responses to wolf removal. Although low snow accumulations made wolf removal difficult, 101 wolves, or 73% of the 1984 pre-reduction estimate, were removed from the Kechika reduction area. In the portion of the Kechika where wolves were removed, the number of moose calves/100 cows increased from 12, in March 1982, to 58, in March 1984 (+ 483%); by contrast, calf numbers declined from 19/100 cows to six during the corresponding period in the untreated area (- 68%), resulting in a ten-fold difference in calf survival between the two areas. Between 1982-1984 wolf density increased from 93 km^2/wolf to 49 km^2/wolf in the untreated area. Mountain sheep in the wolf reduction area had twice as many lambs and yearlings per 100 adult ewes as those in the untreated area. Immigration of wolves into the small reduction area by winter appears to be confounding the survival of the mountain sheep there.

INTRODUCTION

Ungulates have co-existed with wolves for thousands of years. Thus, it follows that there are natural mechanisms which allow mountain sheep, moose, and other ungulate populations to survive at least at minimal numbers in the face of wolf predation. Unfortunately there are no longer systems uninfluenced by man. Further, escape of ungulates from population control by wolves appears to be infrequent and short-lived in the absence of wolf control (Bergerud 1983, Mech and Karns 1977, Keith 1983). While in some cases ungulate declines may be triggered by weather or man's influence, wolf predation alone appears sufficient to maintain a downward slide of ungulate numbers (Gasaway et al. 1984). High or even moderate densities of ungulates and wolves are not maintainable without some form of occasional wolf reduction.

Ungulate declines in the northeast of B.C. have been extensive and severe, impacting on hunters desiring to utilize wildlife as a food source as well as on residents who depend on them.

The key indicator identified in the declines was widespread low juvenile recruitment relative to adult mortality, with wolves implicated as one of the most likely causative factors (Bergerud 1978, Elliott et al. 1984). Consequently, the Kechika Enhancement project was initiated to test the effectiveness of wolf control as a method of increasing recruitment and, in time, ungulate numbers.

This report examines the role of wolf predation in the declines of moose and mountain sheep in the Kechika area of northeastern B.C. It specifically describes work completed during the 1983/84 fiscal year and wolf/ungulate population responses to treatment so far affected. Reports on the two previous years of work are presented in Elliott and Webster (1982) and Elliott (1983). A detailed area description is given in the first annual report (Elliott and Webster 1982), and an initial working plan describes methods (Elliott 1982). A revised working plan is now available (Elliott 1984). Figure 1 indicates the location of areas referenced in the report.

METHODS

DEFINITIONS AND EXPERIMENTAL DESIGN

The original design looked at identifying the effects of predation and habitat status on Stone's sheep and moose through dividing the study area into eight units (moose or mountain sheep versus enhanced or unenhanced range, versus high or low wolf numbers) (Elliott 1982). Modifications of this design have been necessary. Firstly, although some range enhancement through burning occurred for mountain sheep, the burning program in the Kechika was reduced in scope and in consequence the effect of range enhancement could not be evaluated. Secondly, the immigration of wolves into the low wolf area was so rapid that a one time per year reduction

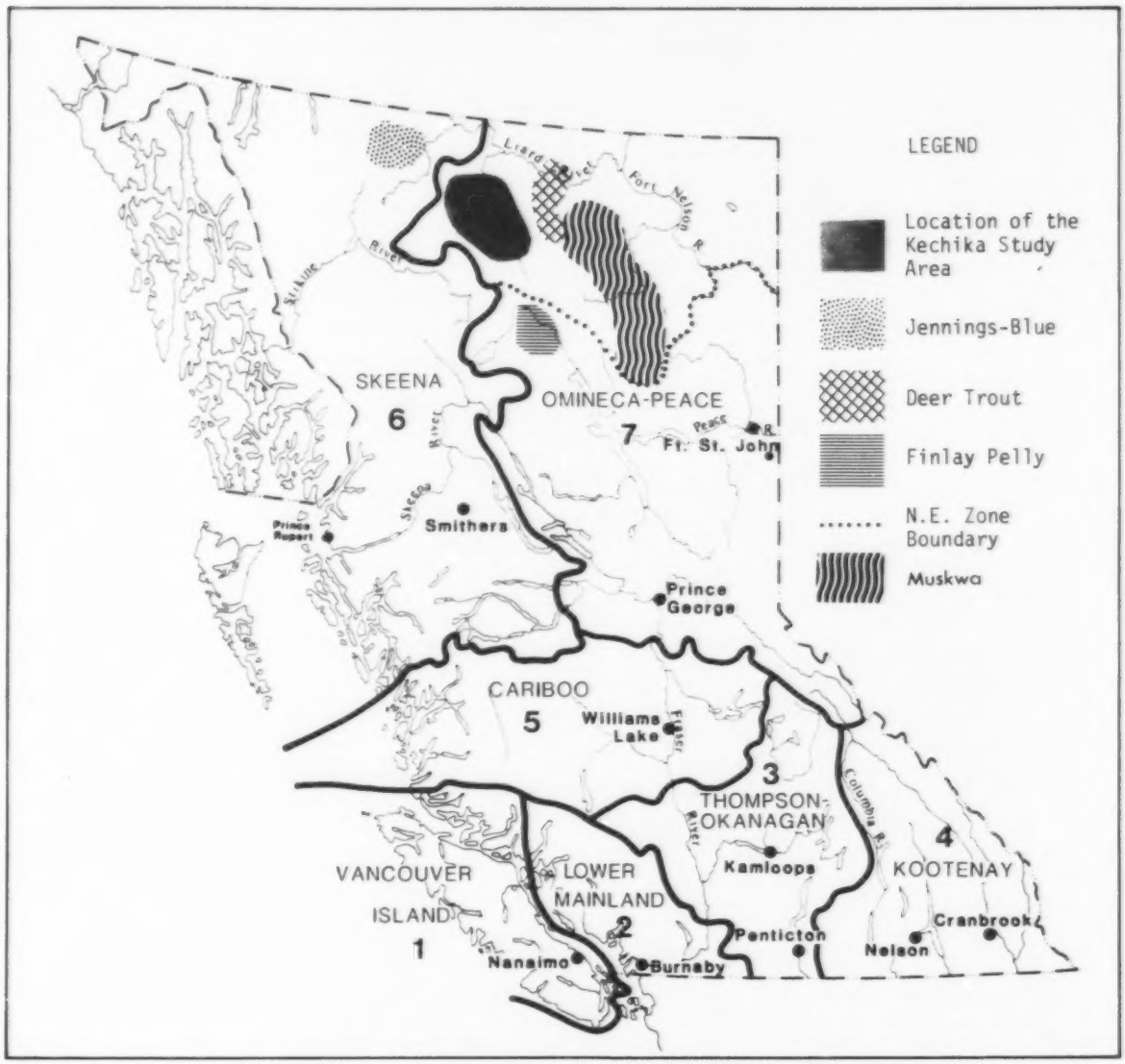


Figure 1. Map of British Columbia showing the location of areas referred to in the text and the zonal NE administration boundary.

did not achieve low wolf numbers for any duration. Work especially in Alaska (Gasaway 1984, pers. comm.) identified this problem, with ca 15 000 - 20 000 km^2 (6000 - 8000 mi^2) being considered as the smallest practical unit for effective wolf removal. As a result, the reduction area has been extended each year working towards that minimum effective reduction area.

The original location of the comparison areas has also proven difficult due to their close proximity to the treated areas. For 1983-1984 comparisons, a buffer zone (Fig. 2) was defined between the comparison and treated areas. An area of greater separation has been defined and surveyed for use as a comparison in 1984-1985 (Deer-Trout; Fig. 3). It is further proposed to commence monitoring of an alternate comparison area (the Jennings-Blue) in 1984-85. A further alternate (the Finlay-Pelly) may also be incorporated. However, additional information is required for those two areas.

Recruitment in this report is defined as the proportion of a population of a given age or older, for one or both sexes - which that given age group comprises. Thus, for example, the recruitment (R) of ten month calves of both sexes is calculated from field ratios obtained when calves are ten months of age by the formula:

$$R = \frac{\text{calves}}{\text{calves \& adults}}$$

Similarily, the recruitment of 18 month female yearlings is calculated from field ratio obtained when yearlings are 18 months of age by the formula:

$$R = \frac{\text{female yearlings}}{\text{female yearlings \& adult cows}}$$

The finite rate of population increase (λ) can be calculated from recruitment and mortality (beyond the age of recruitment (M)) by the formula:

$$\lambda = \frac{1 - M}{1 - R}$$

WOLF SURVEYS AND REDUCTION

Wolves were removed in February-March from progressively increasing portions of the study area in 1982, 1983, and 1984 (Fig. 3). In addition, wolves were inventoried over the entire study area during those periods.

Wolves were removed and inventoried utilizing a combination of aircraft. Inventory proceeded by flying grids of likely wolf travel routes until fresh sign was encountered. Trails were then followed until either the wolves were spotted, or the tracks separated sufficiently to enable a count. When necessary, track counts were confirmed by landing and examining the sign in detail from the ground.

Wolf removal was undertaken by government personnel from a Bell 206 helicopter. Conventional shotguns loaded with SSG shot were used. Wolf density was to be reduced to a one wolf/260 to 390 km^2 (100 to 150 mi^2) level or to approximately 20% of the pre-reduction numbers. This density was chosen to allow

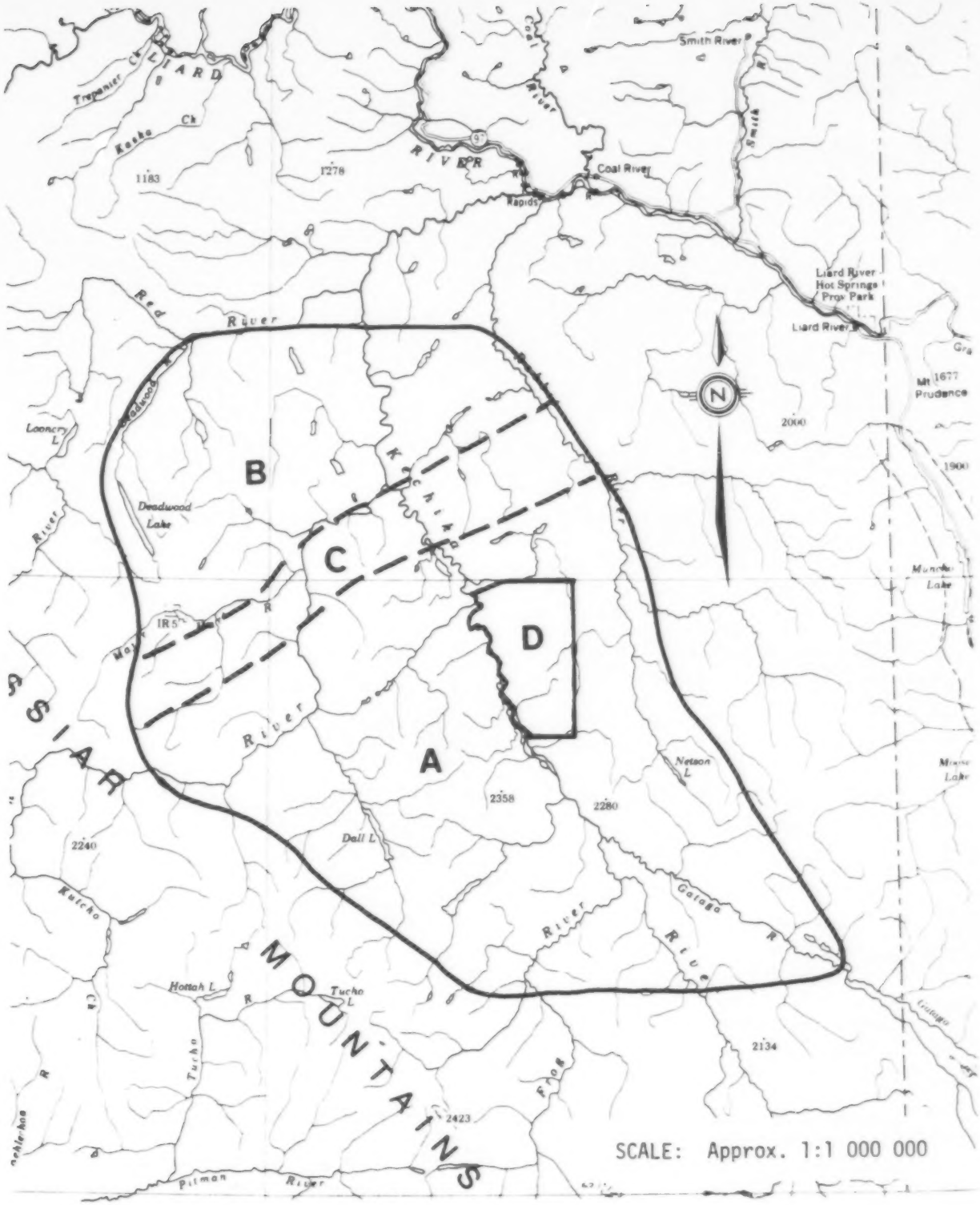


Figure 2. Map of Kechika study area showing 1983 boundaries (A: wolf reduction, B: untreated area, C: buffer zone), and the relative size and location of the Middle Creek moose density survey area (Fig. 4; D).

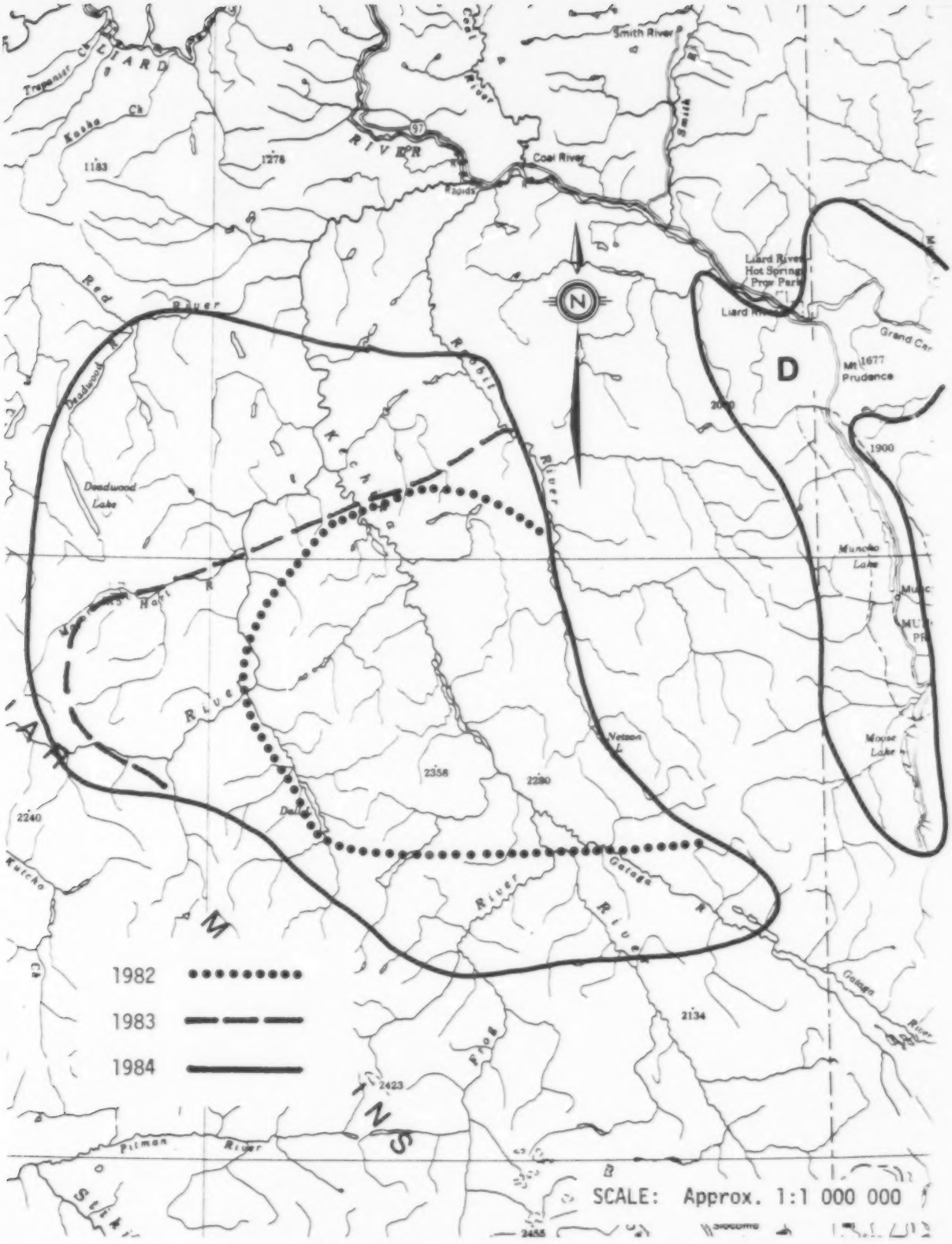


Figure 3. Map showing the boundaries of the 1982, 1983 and 1984 wolf reduction areas and the relative position of the 1984 Deer-Trout comparison area (Fig. 8; D)

clear response identification, yet maintain a substantial minimum wolf population. Areas with wolves removed are referred to as "reduction" areas, while test-control comparison areas are referred to as "untreated" areas throughout the text and in tables.

MOOSE SURVEYS

Transects were flown in the autumn and late winter periods each year to estimate the age and adult sex ratios of moose. Transects were uniformly spaced, straight lines (modified where necessary for feasibility in rough topography) and predetermined on 1:250 000 topographic maps. It was felt that this sampling pattern would be random relative to moose distribution. In the autumn, moose were classified as to calf, yearling male, adult male, or non-calf female based upon size, presence or absence of antlers, and antler configuration. In winter, they were classified as to calf, non-calf male, or non-calf female based upon shape, size, presence or absence of vulval hair, head colouration, and presence or absence of antler scars. The proportion of yearlings (both sexes) was estimated by doubling the number of yearling males classified, thus assuming a 50:50 sex ratio.

Autumn transects were flown by fixed wing, while late winter transects (when the animals are difficult to classify due to absence of antlers) were flown by helicopter under relatively favourable terrain and cover conditions. The proportion of the total moose population seen was not measured but it is assumed that there was no visibility bias for the different age/sex categories, except as noted in the results.

Moose density was estimated for the Middle Creek area by stratified random block surveys using a ratio estimator (Gasaway et al. in prep). The survey area was located well within the boundary of the wolf reduction area and comprised about 11% of the 1982 reduction area or 4% of the 1984 reduction area (Fig. 4). Sample units were polygons whose boundaries were defined by recognizable landscape features such as gulleys, ridges, and streams. No sightability correction factor was determined, although blocks were searched intensively by flying closely spaced parallel transects with a helicopter to ensure few moose were missed. Potential survey bias is regarded as insignificant, in view of the anticipated differences in densities.

MOUNTAIN SHEEP SURVEYS

All mountain sheep habitat types over differing elevations and aspects were searched in all survey units in an attempt to locate all adult females and juveniles per unit. Juveniles were classified as either 9 months or 21 months. The wide distribution and smaller group sizes of males made it impractical to aim for a total count for this component outside of the ewe-juvenile areas.

Mountain sheep were inventoried using a Bell 206 Jet Ranger helicopter on clear, calm days, with temperatures around -20C. This machine was equipped with bubble windows in the rear and an internal communication system. Speed and closeness were varied so that both observers were placed optimally according to the visibility.

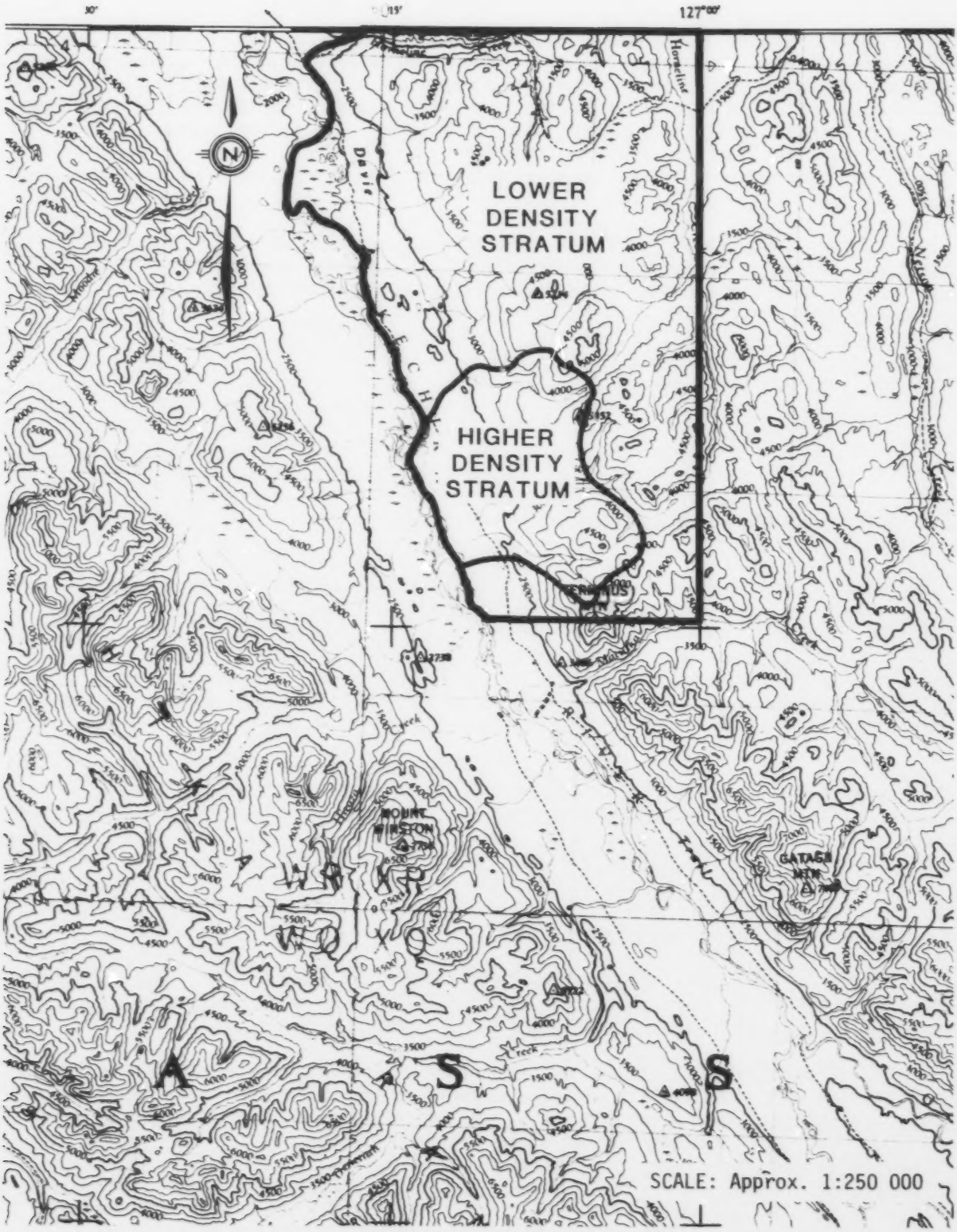


Figure 4. Middle Creek moose density area.

Upon locating a group, the helicopter approached slowly, usually from slightly below or behind the sheep, while the observers obtained a total count. Particularly where the sheep were in open terrain, the approach usually caused them to move upslope in a line or separate into small groups facilitating classification. In rough terrain, the sheep tended to group together and a close (20 to 30 m), slow approach was required to separate them for classification. Where large groups of sheep were encountered, they were classified from the ground using a spotting scope.

In the event fresh sign was observed and sheep were not located, local searching intensity was increased until the group was located. The openness of most of the ranges plus snow cover make this a useful technique.

RESULTS AND DISCUSSIONS

WOLF SURVEY AND REDUCTION

In 1982, nine packs for a total of 71 wolves, out of an estimated 88, were encountered in the reduction area; 70 (80%) of these were removed (Table 1, Fig. 5).

In 1983, 17 packs and five singles were encountered, for a total of 95 wolves in the reduction area, out of an estimated 107; 89 (83%) of these were removed (Table 2, Fig.6).

In 1984, out of an estimated total of 138 wolves, 106 were encountered in the reduction area; 101 (73%) were removed (Table 3, Fig. 7). Some wolves were also removed by hunters and trappers in the northwestern portion of the survey area, which will be included in the 84/85 reduction area. It can be seen that winter wolf numbers in the untreated area appear, at least temporarily, to have stabilized. Considering the substantial immigration to the reduction area, apparently primarily in the fall (Elliott 1983), the seeming stability in the untreated area likely results from emigration of wolves into that vacuum.

Figure 8 and Table 4 summarize the 1984 wolf numbers for the Deer-Trout comparison area. At one wolf per 31 km^2 (12 mi^2) it is approximately what would be expected for the Kechika in the absence of the recent limited wolf reductions.

The proportion of black wolves seen in the removal area changed among years. In 1984, 54 (51%) of the 106 wolves seen were gray, while the remaining fifty-two (49%) were black. This contrasts to 19 percent black wolves in 1982 and 60 percent in 1983. It was expected in an immigration situation that blacks would attain increased proportions over the undisturbed colour ratio through more aggressive colonization. Work with birds (O'Donald 1977) has shown that increased melanism within a species is associated with more aggressive (and thus appropriate to colonizing) behaviour. The shift, therefore, is an indication of immigration into the vacumn created through reduction.

Sex ratios of wolves removed have remained essentially constant during the removal program. Fifteen (31%) of 49 wolves of known sex in 1984 were females. This compares to 49 percent in 1982 and 47 percent in 1983. Fifty-four percent of the 1984 gray wolves were female, while forty-eight percent of the black wolves were female. Eleven (27%) of 41 wolves of known age were young of the year.

MOOSE SURVEYS

The 1983 autumn moose survey showed that the estimated calf and yearling survival in the wolf reduction area was significantly higher than that in the untreated area (Table 5). Indeed, there were proportionally ten times as many calves in the reduction as in the untreated area. Table 6 presents the results of the late winter survey. It must be remembered, that those are samples with only the proportions comparable between Tables 5 and 6, not the absolute values. Mortality since the autumn survey does not appear to have been selective for calves as calf:100 cows ratios remained unchanged between November and March. The overall survival of calves in the wolf reduction area is significantly higher than that in the untreated area with proportionally ten times as many moose calves in the reduction area (Table 6). This indicates that the differential calf mortality occurred prior to the autumn survey while wolf density in the reduction area is still low.

Assuming that the fall bull to cow, and yearling to adult ratio, are the same for 1981 as those of 1982, late winter calf to adult cow ratios can be derived for three years (Table 7). (Recall that winter adult cow determinations assume no change in yearling to adult ratios since November.) It can be seen that for the untreated area, where the summer wolf numbers were increasing each year, the moose calf proportions declined. In contrast, in the reduction area where wolf numbers were lowered prior to the calving and summer period, the moose calf proportions increased.

Table 8 presents moose proportions for the Deer-Trout comparison area. This area of high (31 km^2/wolf) wolf density had nine calves per 100 cows in 1984.

Moose density was estimated for the Middle Creek unit, a representative portion of the study area (Fig. 4). It is situated within the wolf reduction area and covers approximately 419 km^2 (161 mi^2). It had had reduced wolf numbers for two years prior to the density estimate survey and so probably had higher moose densities than before wolf control. Table 9 presents the results for the 22 blocks (averaging 5.4 km^2 and in total 28% of the Middle Creek area) searched. In sum, 111 moose were seen with 35 bulls (1+) and 41 calves per 100 cows (1+). The estimated population was 289+ 19%, with 90% confidence limits. This gives 0.7 moose per square kilometer (1.8/mi^2). The estimate in the low stratum was 171 (0.5 moose/km^2) and 118 (1.5 moose/km^2) for the high stratum (1.3/mi^2 and 3.9/mi^2 respectively).

From the herd estimate by stratum it follows that there are 55 bulls (1+), 167 cows (1+) and 68 calves (41 calves/100 cows). Utilizing the autumn yearling to adult proportions this would correspond to 38 bulls (2+), 17 yearling bulls, 140 cows (2+), 27 yearling cows, and 68 calves. This gives 0.34 cows (2+) per km^2 (0.87/mi^2) and 0.43 adult (2+) moose/km^2 (1.11/mi^2) for the Middle Creek area, following two years of wolf reduction.

The Middle Creek area is planned for resurvey in 3 years time. Van Ballenberghe and Dart (1982) suggest a maximum finite rate of increase (λ) of 1.14 in an Alaskan moose population. Thus with an estimate of 289 moose in 1984, 428 moose are projected in 1987 ($289(1.14)^3$) or a 48% increase. The required variance for the 1987 survey, based on detecting a 40% increase in population size, with $\alpha = 0.10$ and $\beta = 0.20$ is < 1834 (see Gasaway et al. 1983). As $S^2 = 966$ in 1982, a survey of similar intensity is anticipated for 1987.

MOUNTAIN SHEEP SURVEYS

Table 10 presents results of the 1984 late winter mountain sheep surveys in relation to habitat enhancement (burning in a variety of habitat types) and the presence or absence of wolf reduction. The 1981 untreated wolf area burns were in the lightest (grass-shrub) fuel, 1981 wolf reduction area burns the next lightest (shrub) and the 1982 burns in the heaviest (shrub-trees) fuel. There is a clear pattern relative to the predation effect. Overall, twice as many lambs and yearlings per ewe can be seen to be surviving in the reduction versus the untreated wolf density areas. Burning had only a slight effect on proportional lamb survival.

Table 11 summarizes the juvenile proportions for the last three years. It can be seen that while juvenile proportions in the untreated wolf area have declined in response to increasing wolf numbers there, juvenile proportions in the reduction area have remained stable. Winter wolf numbers, due to the small size of the reduction area, have remained approximately constant (rather than increasing as in the untreated area) and it appears that much of the mountain sheep mortality to wolves may occur in the winter as discussed in Elliott and Webster (1982).

Table 12 presents mountain sheep juvenile proportions for the Deer-Trout area. These are similar to those in the untreated section of the Kechika study area.

Table 1. Wolf status in the Kechika study area, February - March, 1982.

Treatment areas	area km²	area (mi²)	number wolves	km² /wolf	(mi²) /wolf	number wolf packs*	km² /pack	wolves /pack*
untreated area	6009	2320	65	93	(36)	11 (+1 wolf)	546	5.8
reduction area pre-reduction	3833	1480	88	44	(17)	13	295	6.8
reduction area post-reduction	3833	1480	18	213	(82)	4 (+1 wolf)	958	4.3

*excludes single wolves

Table 2. Wolf status in Kechika study area, February - March, 1983.

Treatment areas	area km²	area (mi²)	number wolves	km² /wolf	(mi²) /wolf	number wolf packs*	km² /pack	wolves /pack*
untreated area	2720	(1050)	57	48	(18)	8 (+2 singles)	340	6.9
reduction area pre-reduction	7123	(2750)	107	67	(26)	21 (+5 singles)	339	4.9
reduction area post-reduction	7123	(2750)	18	396	(153)	5 (+4 singles)	1425	2.8

*excludes single wolves

Table 3. Wolf status in Kechika study area, February - March, 1984.

Treatment areas	area km²	area (mi²)	number wolves	km² (mi²) /wolf	number wolf packs*	km² /pack	wolves /pack*
untreated area	3509	1355	71	49 (19)	10 (+1 single)	351	7.0
reduction area pre-reduction	9961	3846	138	72 (28)	29 (+7 singles)	343	4.5
reduction area post-reduction	9961	3846	33	302 (117)	**	**	**

*excludes single wolves
**no packs evident following reduction

Table 4. February - March, 1984. Wolf status in the 1984-1985 comparison area.

Category	Value
Land area	3046 km² (1176 mi²)
number of wolf packs	18 plus 2 singles
number of wolves	97
area per pack*	169 km² (65 mi²)
area per wolf	31 km² (12 mi²)
wolves per pack*	5.3

* excludes single wolves

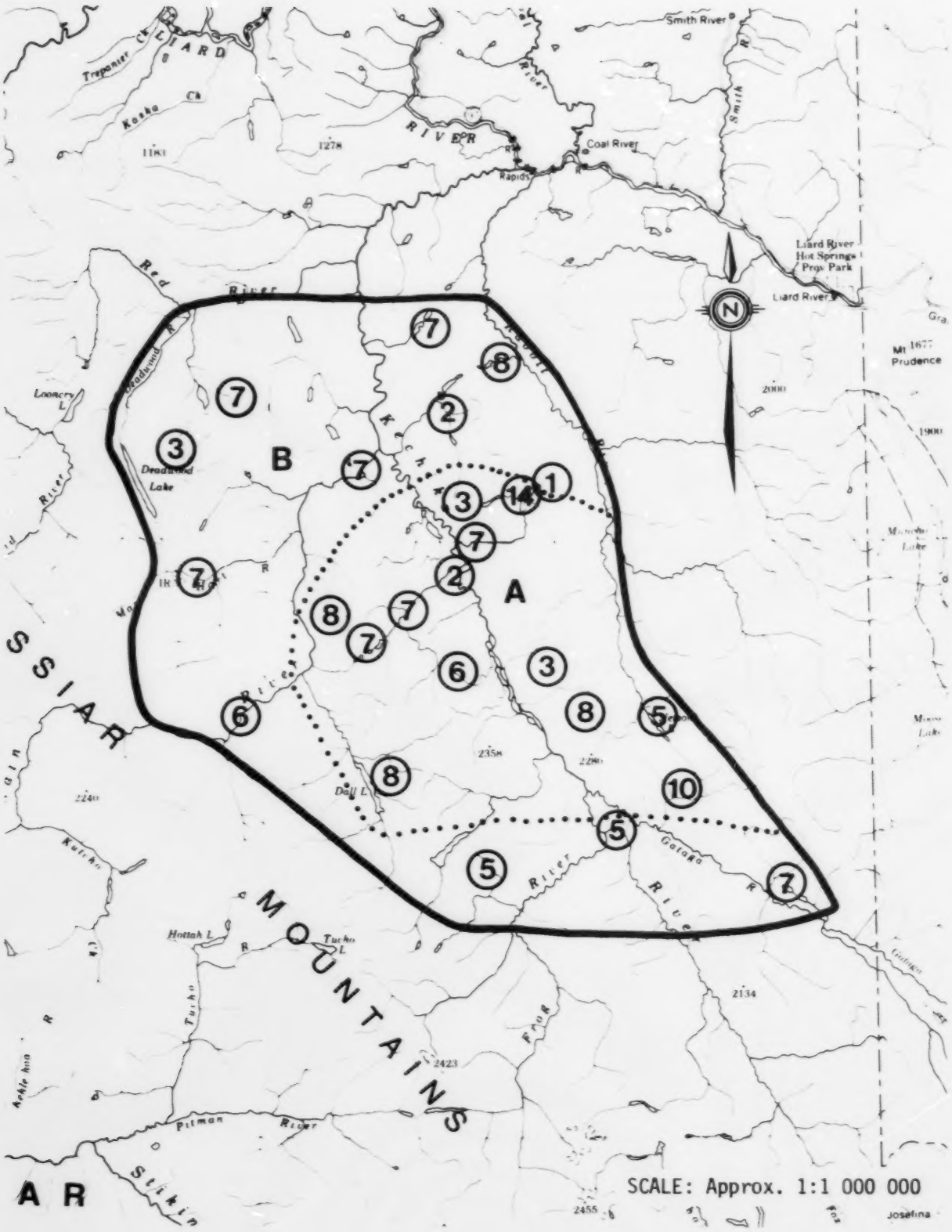
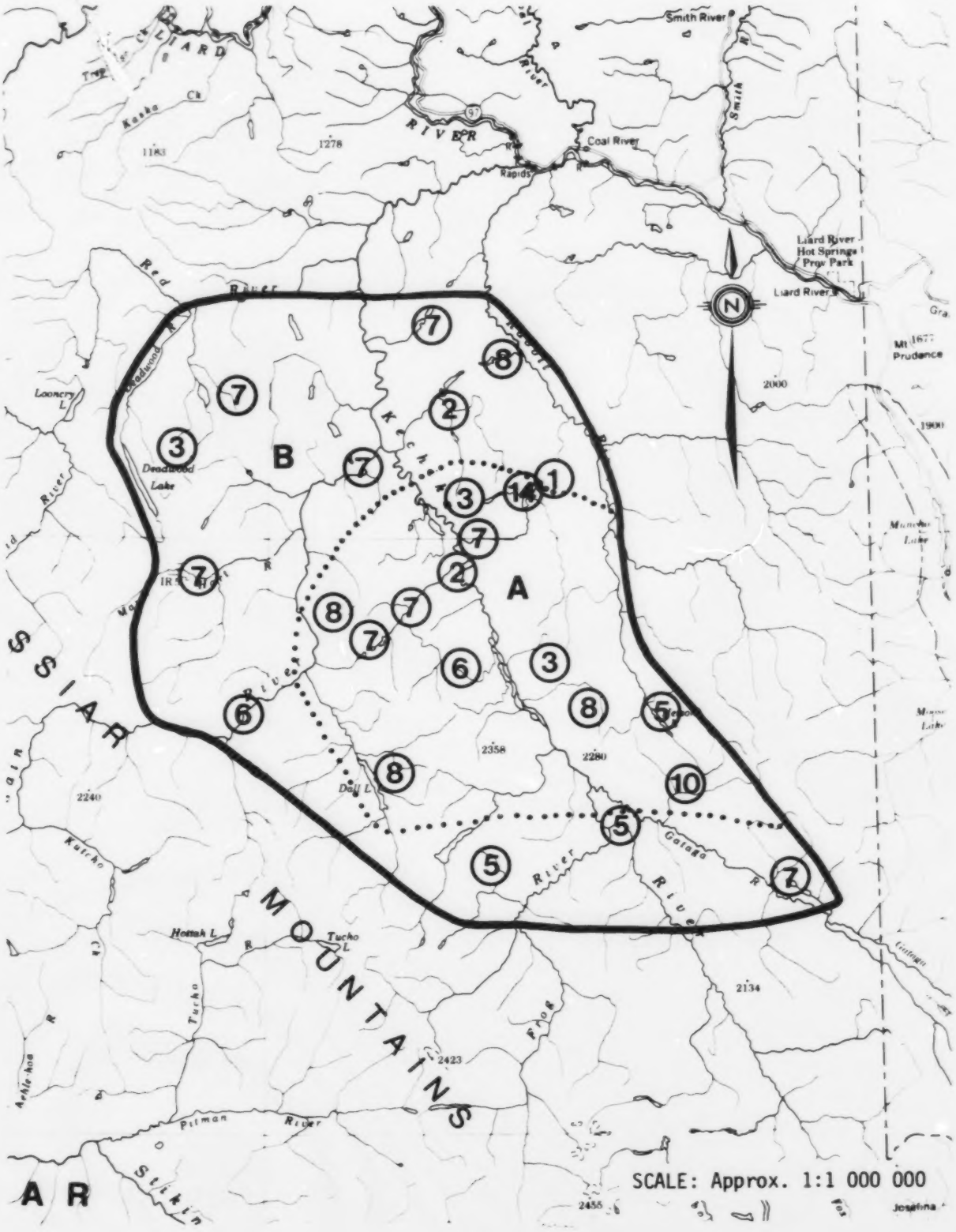


Figure 5. 1982 wolf pack sizes prior to reduction (A: wolf reduction area; B: untreated area).



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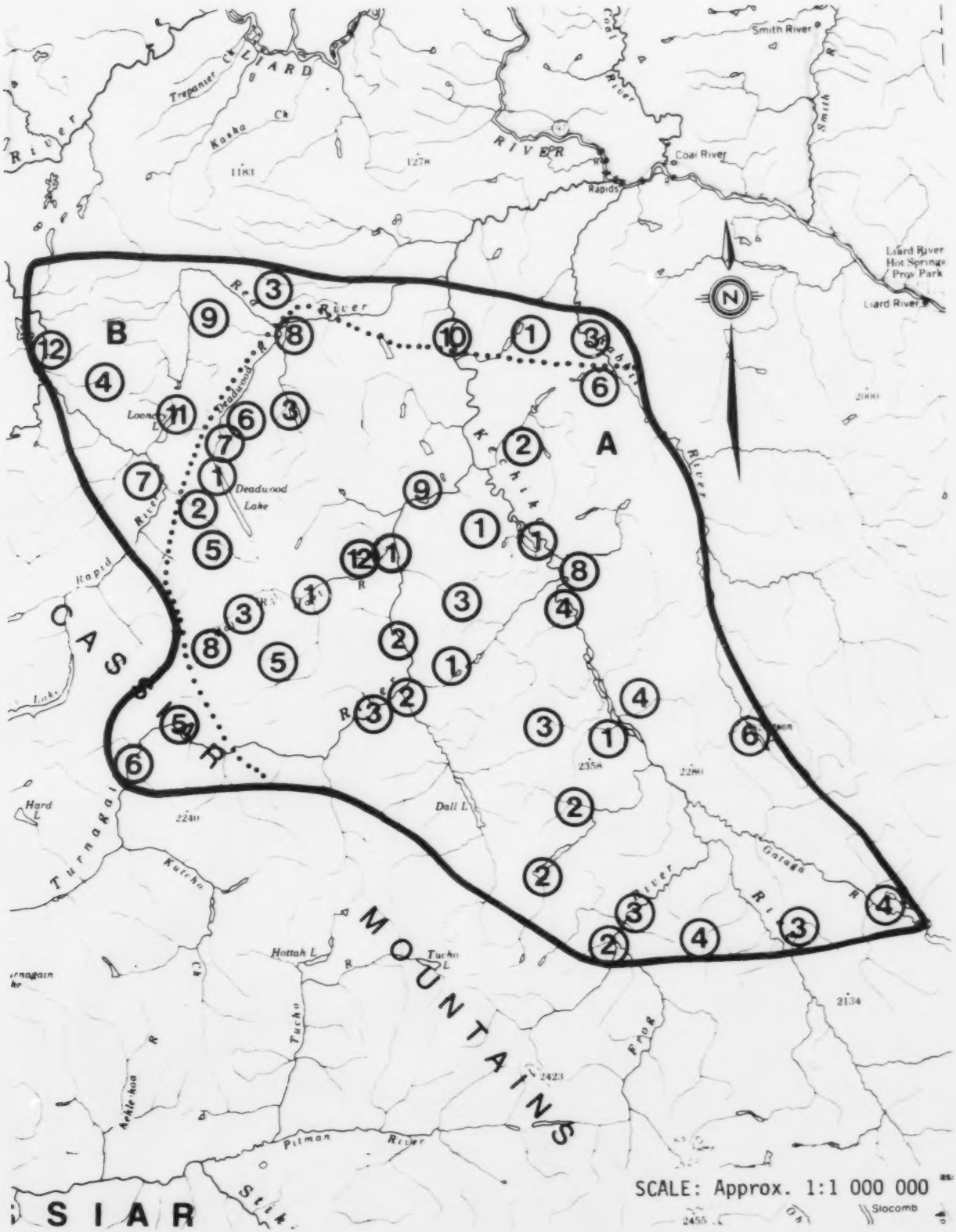

Figure 7. 1984 wolf pack sizes prior to reduction (A: wolf reduction area; B: untreated area).

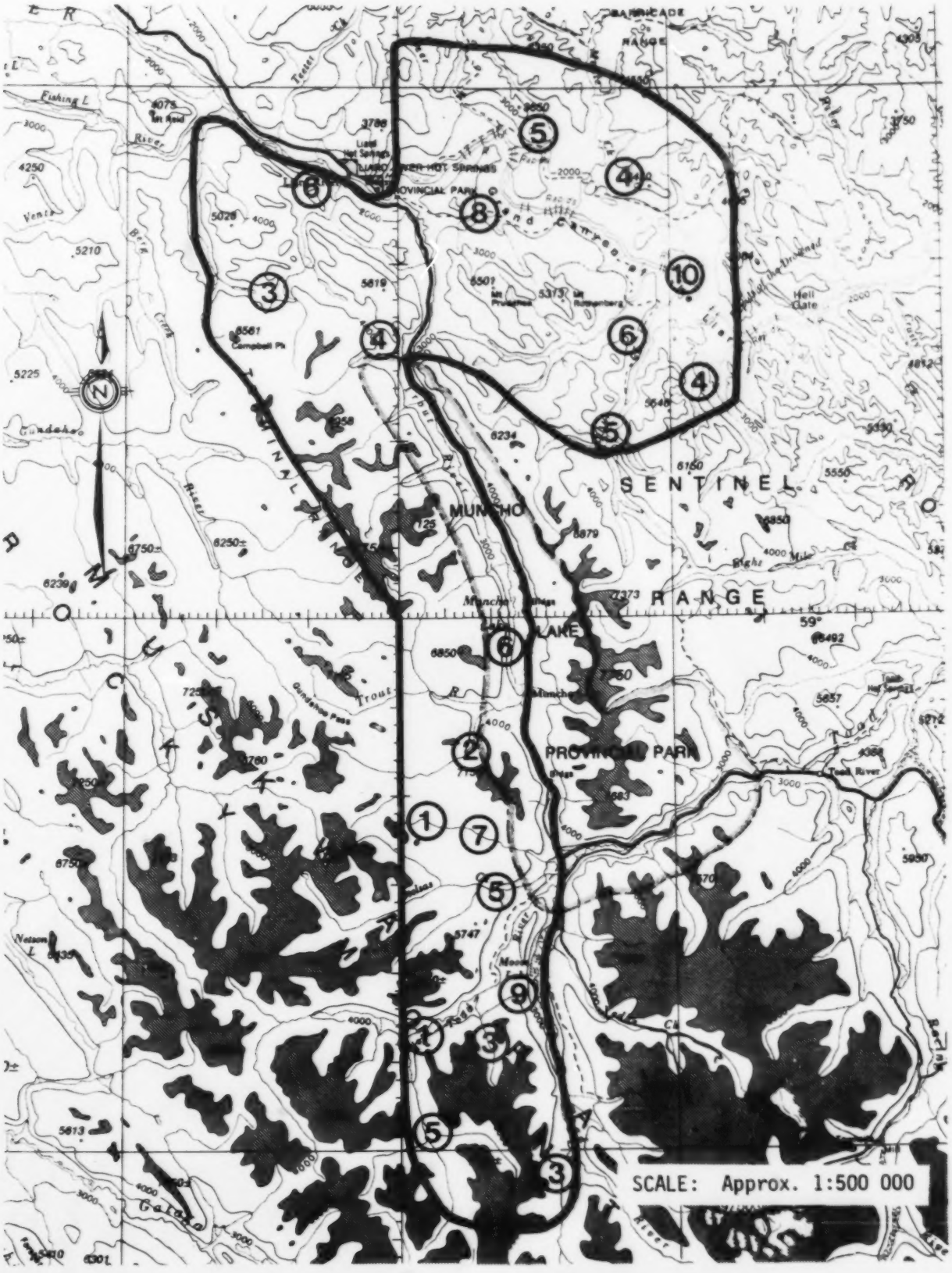

Figure 8. 1984 Wolf pack sizes for the Deer-Trout comparison area.

Table 5. Moose population composition for untreated and reduced wolf density areas in November, 1983.

Area	Number[1]				
	Bulls (2+)	Cows (2+)	Yearlings[2]	Calves	Total
untreated	47 (75)	63	10 (16)	4 (6)	124
wolf reduction	105 (43)	246	94 (38)	143 (58)	588

[1]number per 100 cows (2+) in brackets
[2]assumes a 50:50 sex ratio

chi square (yearlings to cows) = 6.206 (0.025> probability of similarity>0.010)

chi square (calves to cows) = 24.806 (0.005> probability of similarity)

Table 6. Moose population composition for untreated and reduced wolf areas, February - March, 1984.

Area	Number[1]			
	Bulls (2+)[2]	Cows (2+)	Calves	Total
untreated	31 (46)	67	4 (6)	102 (+10 yearlings)
wolf reduction	27 (41)	66	38 (58)	131 (+24 yearlings)

[1]number per 100 cows (2+) in brackets
[2]assumes the adult (2+) to yearling ratio is unchanged from autumn

Chi square (calves to cows) = 22.094 (0.005>probability of similarity)

Table 7. Estimated number of calves per 100 adult (2+) cow moose for untreated and reduced wolf density areas, February - March 1984.

Year	Wolf density areas	
	untreated	reduced
1982*	19	12
1983	12	33
1984	6	58

*wolves not yet reduced, at this time the "reduced wolf area" contained a higher density of wolves than the "regular wolf area"

Table 8. Moose proportions in the Deer-Trout Area. February - March, 1984.

Segment	Number Seen	Number per 100 Cows (1+)
Bull (1+)	42	62
Cow (1+)	68	100
Calf	6	9
	116	

Table 9. Moose seen in intensively searched sample blocks in the Middle Creek area subunit, March 1984

Block #	Area		Number Seen			
	km^2	(mi^2)	Bulls (1+)	Cows (1+)	Calves	Total
1	4.7	(1.8)	--	3	1	4
2	3.5	(1.4)	1	1	1	3
3	4.9	(1.9)	2	2	1	5
4	3.6	(1.4)	--	2	2	4
5	2.8	(1.1)	--	--	--	--
6	5.7	(2.2)	--	2	2	4
7	5.1	(2.0)	2	1	1	4
8	3.4	(1.3)	--	2	--	2
9	4.4	(1.7)	--	--	--	--
10	8.0	(3.1)	--	3	--	3
11	4.5	(1.7)	--	2	--	2
12	4.4	(1.7)	--	--	--	--
13	3.8	(1.5)	1	--	--	1
14	4.6	(1.8)	--	2	--	2
18	4.3	(1.6)	--	--	--	--
Sub-total	67.6	(26.1)	6	20	8	34
15	8.6	(3.3)	1	5	--	6
16	7.8	(3.0)	--	6	2	8
17	7.3	(2.9)	4	11	5	20
19	9.1	(3.5)	4	6	5	15
20	7.8	(3.0)	2	5	3	10
21	6.2	(2.4)	3	8	2	13
22	4.0	(1.5)	2	2	1	5
Sub-total	50.8	(19.6)	16	43	18	77
GRAND TOTAL	118.4	(45.7)	22	63	26	111

Table 10. Response of Mountain Sheep to differing wolf densities and prescribed fire, February - March, 1984.

	Lamb and yearling: 100 ewes					
	wolf reduction area			untreated area		
Range	lambs	yearlings	sample size	lambs	yearlings	sample size
some burned 1981	35.3	8.7	298	18.8	7.7	229
some burned 1982	44.0	23.0	167	18.5	7.4	34
unburned	34.1	17.1	62	17.0	7.0	124
all	37.6	13.8	527	18.2	7.5	387

Reduction area versus untreated area: Chi square (lambs to ewes) = 17.15; probability of similarity <0.005
Chi square (yearling to ewes) = 5.47; probability of similarity $0.01 < p < 0.025$

Table 11. Juvenile mountain sheep proportions, based on 1982-84 February - March aerial surveys.

	Area					
	wolf reduction area			untreated area		
Year	lambs/ 100 ewes*	yearlings /100 ewes*	sample size	lambs/ 100 ewes*	yearlings /100 ewes*	sample size
1982**	36.3	15.5	1559	34.1	18.0	473
1983	41.0	11.6	639	19.2	3.9	411
1984	37.6	13.8	527	18.2	7.5	387

* ewes = females 2+ years old.
**wolves not yet reduced

References: 1982 (Elliott & Webster 1982), 1983(Elliott 1983) and 1984 (present report).

Table 12. Mountain Sheep juvenile proportions in the Deer-Trout comparison area February - March 1984.

Component	Number Seen	Number per 100 ewes (2+)
ewes	54	--
lambs	10	18.5
yearlings	5	9.3
	69	

CONCLUSIONS

It is premature at this stage to draw definitive conclusions on the practicability of temporary wolf population reduction in the reversing of major declines and enhancing of numbers in wild ungulate populations. Nevertheless, based on three years data the following tentative conclusions are suggested:

a) The strong positive response in moose calf and yearling survival, and the less apparent improvement in mountain sheep lamb and yearling survival, indicate that wolf predation was a major factor in prey declines;

b) The annual recolonization of reduction areas by wolves from neighbouring areas, which occurs by next winter and which is indicated by a shift in colour phases, suggests that:
   i) the program does not endanger the future, long term status of wolves within the reduction areas,
   ii) the reduction areas must be large enough to provide an effective seasonal relief to juvenile ungulates from wolf predation.

c) Late winter wolf reduction primarily benefits moose populations while late autumn/early winter reduction would provide more effective protection to mountain sheep on winter ranges;

d) Under prevailing conditions, particularly with fresh snow cover, wolf populations can be effectively reduced by using a combination of spotter aircraft and helicopters;

e) The continuation of the project is essential to provide:
   i) an adequate data base from which to draw final conclusions,
   ii) sufficient ungulate population recovery to a level which can withstand moderate levels of wolf predation.

f) The closure on the harvest of juvenile and female age and sex groups should be continued throughout the project period;

g) In the designing of future management programs care should be taken to assign an adequate initial area of predator reduction to compensate for the confounding effect of immigration from neighbouring areas.

REFERENCES

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Fish and Wildl. Branch Rep., Victoria, B.C. 150pp.

_____. 1983. The natural population control of caribou. Pages 14-61 in F.L. Bunnell, D.S. Eastman, and J.M. Peek, eds. Symposium on natural regulation of wildlife populations. For., Wildl., and Range Exp. Sta., Univ.of Idaho, Moscow.

Elliott, J.P. 1982. Kechika enhancement project: working plan. Fish and Wildl. Branch, Ministry of Environ., Victoria, B.C., Unpubl. rep.

_____. 1982. Muskwa project, Draft problem analysis/working plan. Fish and Wildl. Branch, Ministry of Environ., Victoria, B.C., Unpubl. rep.

_____. 1983. Kechika wolf project. 1982-83 annual progress report. Fish and Wildl. Branch, Ministry of Environ., Victoria, B.C. Unpubl. rep.

_____. 1984. Kechika enhancement project of northeastern B.C. Revised working plan for 1984-87. Fish and Wildl. Branch, Ministry of Environ., Victoria, B. C. Unpubl. rep.

_____, and B. Webster 1982. Kechika wolf project. 1981-1982 annual progress report. Fish and Wildl. Branch, Ministry of Environ., Victoria, B.C., Unpubl. rep..

Elliott, J.P., D. Eastman, D. Hatler, and I. Hatter. 1984. Northern B.C. Wolf-Caribou Study. B.C. Ministry of Environment, Wildlife Branch, Victoria unpubl.

Gasaway, W.C., S.D. Dubois, S. Harbo, and D.J. Reed (in prep). Estimating moose demography from aerial surveys. Alaska Dep. Fish and Game.

Gasaway, W.C., R.O. Stephenson, J.L. Davis, P.E.K. Shepherd, and O.E. Burris. 1983. Interrelationships of wolves, prey, and man in interior Alaska. Wildl. Monogr. 84. 50pp.

Keith, L.B. 1983. Population dynamics of wolves. Pages 66-77 in L.N. Carbyn, ed. Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. Ser. 45. Ottawa.

Mech, L.D., and P.D. Karns. 1977. Role of the wolf in a deer decline in the Superior National Forest. U.S. Dep. Agric. For. Serv. Res. Rep. NC-148, North Cent. For. Exp. Sta., St. Paul, Minn.

O'Donald, P. 1977. Mating preferences and sexual selection in the Arctic Skua. Heredity 39:111-120.

Van Ballenberghe, V., and J. Dart. 1982. Harvest yields from moose populations subject to wolf and bear predation. Alces 18:258-275.

Wildlife Working Reports should not be cited because of the preliminary nature of the data contained within.

WR-1 Progress report - coastal grizzly research project: Year 1. A.N. Hamilton. October 1984. 32pp. (Also printed as WHR-9).

WR-2 Progress report - coastal grizzly research project: Year 2. A.N. Hamilton and W. R. Archibald. October 1984. 30pp. (Also printed as WHR-10).

WR-3 Telemetry: Comments and suggestions from the coastal grizzly project 1983. A. E. Derocher. October 1984. 14pp. (Also printed as WHR-11).

WR-4 Habitat types of the Kimsquit River estuary. C. Clement. October 1984. 27pp. (Also printed as WHR-12).

WR-5 Biogeoclimatic units and ecosystem associations of the Kimsquit drainage. C. Clement. October 1984.. 93pp. (Also printed as WHR-13).

WR-6 Kechika Enhancement Project of Northeastern B.C.: Wolf/Ungulate Management. 1983-84 Annual Report. J. P. Elliot. October 1984. 25pp.